GROUND WATER ASSESSMENT 2002 Draft 3/27/02

Introduction to Indiana Ground Water

Ground water is an important resource for Indiana citizens, agriculture, and industry. The majority of the state's population use ground water for drinking water and other household uses. Of the population served by public water supplies, approximately 50 percent depend on ground water. In 2000, 4154 public water systems supplied ground water to a population of approximately two and a half million people (http://www.in.gov/idem/water/index.html) (IDEM 2000 Annual Compliance Report for Indiana Public Water Systems). Over one-half million Indiana homes have private wells for their water supply. Ground water is also an integral component in Indiana's economy. During the growing season, ground water is withdrawn at an average rate of 282.9 million gallons per day (mgd) for crop and turf irrigation (based on a 90-day season). Industry withdraws an average 98.6 mgd of ground water, and 31.3 mgd is used for energy production (Ralph Spaeth, Indiana Department of Natural Resources, written communication, 2000).

Indiana’s potable ground water occurs in both unconsolidated and bedrock (consolidated) aquifer systems. The most productive aquifers are associated with glacially derived outwash sand and gravel deposits that occur in the major river valleys. Other good unconsolidated aquifers are found in the thick, inter-till sand and gravel deposits and outwashes of central and northern Indiana. The withdrawal potential in unconsolidated aquifers is up to 2000 gallons per minute (gpm). The major bedrock aquifers include the Pennsylvanian Age sandstones of southwestern Indiana, Mississippian Age limestones in the south central area, Devonian Age limestones and dolomites across northern and central Indiana, and Silurian Age limestones and dolomites in the north and central portions of the state. Major bedrock aquifers yield up to 600 gpm.

The ambient ground water quality throughout Indiana is variable and dependent upon the aquifer system, geologic setting, and depth of geologic formation. In general, the incidence of mineralized or even saline ground water increases at bedrock depths that exceed 300 feet. The majority of private and public wells in Indiana occur at depths of less than 200 feet. The chemical quality of the potable water is generally adequate to meet the basic needs for household, municipal, industrial, and irrigation uses. However, the waters are often hard, with hardness exceeding 180 parts per million (ppm) as calcium carbonate. Other constituents of importance to natural water quality are iron, manganese, sulfate, and hydrogen sulfide. Iron and manganese concentrations are often a nuisance, causing staining and deposits. Manganese concentrations are lowest along the Wabash River and Whitewater River and in Mississippian Age limestone aquifers. Sulfate levels are dependent on the geologic deposits. Concentrations exceeding 600 ppm sulfate have been noted in Allen, Harrison, Orange, Vermillion and Lake Counties. Hydrogen sulfide, which has an objectionable odor even at low concentrations, is produced from sulfate by oxidation-reduction reactions or biological reduction by anaerobic bacteria. It is generally present in the ground water underlain by limestone bedrock in northwestern regions of Indiana.

Ground Water Data for the 2002 305(b) Reporting Cycle

Ground water information contained in this report is based on guidelines provided by the USEPA. Among the information provided is an overview of the ten highest priority sources of ground water contamination in Indiana and the associated contaminants impacting ground water quality (Table 25), a summary of Indiana's ground water protection efforts (Table 26), and nitrate sampling results for selected hydrogeologic settings (Table 27). Beginning with the 1996 305(b) report, the EPA requested ground water quality be assessed by hydrogeologic setting(s) or aquifer(s) rather than by county. In 1995, the Indiana Geological Survey (IGS) produced a document that describes 230 surface and subsurface geologic environments, or "hydrogeologic settings", occurring in Indiana. The hydrogeologic settings provide a conceptual model to interpret the sensitivity to contamination of ground water in relation to the surface and subsurface environment (Fleming and others 1995). Included in the descriptions of the hydrogeologic settings are the composition and geometry of the aquifers, thickness and variability of the confining units, surface and ground water interactions, and recharge/discharge relationships. Unless noted otherwise, the 2002 305(b) report contains data for 1999 and 2000.

Major Sources of Ground Water Contamination

The major contaminant sources impacting Indiana ground water as of 1998 are listed by general activity types in Table 25. All sources listed are a potential threat to ground water; however, the degree to which the source is a threat to ground water depends on several factors, probably the most significant being hydrogeologic sensitivity. Other major risk factors include location of the contaminant source relative to drinking water sources, toxicity of the contaminant, and the size of the population at risk. All risk factors listed in Table 25 were considered in selection of the ten priority contaminant sources, and those risk factors relevant to the highest priorities are identified. Classes of contaminants commonly associated with each highest priority contaminant source are also given. Note: Due to resource restraints, the information in Table 25 was not updated from the 2000 305(b) report. However, anecdotal evidence indicates the same major contaminant sources are impacting Indiana ground water now as they were in 1997 and 1998.

Table 25 Major Sources of Ground Water Contamination

CONTAMINANT SOURCE	HIGHEST PRIORITY	FACTORS[1]	TYPE OF CONTAMINANT[2]
Agricultural Activities			
Agricultural chemical facilities			
Commercial fertilizer applications	✓	A, C, D, E	E
Confined animal feeding operations	✓	A, D, E	E, J
Farmstead agricultural mixing and loading procedures			
Irrigation practices			
Manure applications			
Pesticide applications			
Storage and Treatment Activities			
Land application			
Domestic and industrial residual applications			
Material stockpiles			
Storage tanks (above ground)			
Storage tanks (underground)	✓	A, B, C, D, E, F	B, C, D
Surface impoundments	✓	A, C, D, E, F	A, B, C, D, E, G, H, J
Waste piles			
Disposal Activities			
Deep injection wells			
Landfills (constructed prior to 1989)	✓	A, B, C, D, E, F	A, B, C, D, E, G, H, I, J
Permitted landfills (constructed 1989- present)			
Septic systems	✓	A, C, D, E, F, G	A, B, C, D, E, H, J
Shallow (Class V) injection wells	✓	A, B, C, D, E, I	A, B, C, D, E, H, J
Other			
Hazardous waste generators			
Hazardous waste sites			
Industrial facilities	✓	A, B, C, D, E, F	A, B, C, D, E, H, I, J
Liquid transport pipelines (including sewer)			
Materials spills (including during transport)	✓	A, B, C, D, E, F	A, B, C, D, E, H, I, J
Material transfer operations			
Small-scale manufacturing and repair shops			
Mining and mine drainage			
Salt storage (State and nonstate facilities) and road salting	✓	A, C, D, E, F	G
Urban runoff			

[1] Factors considered in selecting the contaminant source:
(A) human health and/or environmental risk (toxicity)
(B) size of the population at risk
(C) location of source relative to drinking water source
(D) number and/or size of contaminant sources
(E) hydrogeologic sensitivity
(F) documented State findings, other findings
(G) high to very high priority in localized areas, but not over majority of Indiana
(H) geographic distribution/ occurrence
(I) lack of information

[2] Classes of contaminants associated with contamination source:
(A) Inorganic pesticides
(B) Organic pesticides
(C) Halogenated solvents
(D) Petroleum compounds
(E) Nitrate
(G) Salinity/ brine
(H) Metals
(I) Radionuclides
(J) Bacteria
(K) Protozoa
(L) Viruses

Nitrate is a potential contaminant from the following high priority sources listed in Table 25: commercial fertilizer applications, concentrated animal feeding operations (CAFOs), and septic systems. Nitrate, a highly mobile and soluble contaminant, is the most frequently detected ground water contaminant in rural areas; however, determining the source of nitrates detected in ground water can be difficult and costly. For more information on nitrate occurrences in Indiana, see Table 27 and its accompanying narrative.

For the 1999 and 2000 crop production season, 537 million tons and 970 million tons, respectively, of commercial fertilizer containing nitrogen were sold in Indiana for application on some 12 million acres of cropland, most of which was applied to nearly 6 million acres of corn (Indiana Agricultural Statistics Service 1999-2000). Unlike pesticides, the purchase and application of commercial fertilizer is not regulated by the Office of the Indiana State Chemist. When applied at the proper rate and time, commercial fertilizer poses little threat of contamination to ground water. Purdue University Cooperative Extension Service staff, United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) staff and private consultants assist crop producers in developing nutrient management plans that focus on meeting crop nutrient needs based on realistic goals.

Concentrated animal feeding operations occur throughout Indiana, as livestock are an integral component of Indiana’s agricultural economy. The Indiana Department of Environmental Management (IDEM) conducts a Confined Feeding approval program which requires large livestock and poultry producers to gain approval for construction, operation or expansion of their facilities. The USDA-NRCS also works closely with livestock producers who request financial and technical assistance for building livestock waste storage facilities and to install or implement conservation practices that serve to reduce soil erosion and nutrient loss. The primary concerns associated with CAFOs are the proper storage and land application of the large volumes of ammonia-containing manure produced by these operations (the ammonia form of nitrogen is converted to nitrate through biological processes in the soil). Consequently, the rate of manure application to farmland is a major concern when the application provides more nitrogen than a crop will use thus allowing excess nitrogen to move into underlying aquifers. On November 1, 2000, the Indiana Department of Environmental management proposed a new confined feeding regulation (327 IAC 16) which provides design, construction and operational performance standards for all state regulated CAFOs. This regulation will assist IDEM in better regulating CAFOs and further reducing the potential of negative impact to surface and ground waters.

Properly constructed and maintained septic systems provide satisfactory on-site treatment of domestic wastewater in rural and unsewered suburban areas of Indiana. However, improperly constructed or poorly maintained septic systems, as well as systems operating in areas of high seasonal water tables or other ground water sensitive areas, are also of concern as a source of nitrate contamination to ground water.

Landfills and underground storage tanks are a high priority ground water contamination concern largely due to practices or activities that occurred prior to construction standards and legislation established for the protection of ground water. Landfills constructed after 1988 have been required to adhere to stringent construction standards. Since 1988, underground storage tank registration, upgrading, closure activity and site assessment have been closely reviewed by the IDEM Underground Storage Tank (UST) Section. In accordance with federal and state mandates, as of December 22, 1998, Underground Storage Tanks installed prior to December 22, 1988, were to be either properly protected against spills, overflows and corrosion, or properly closed.

Class V underground injection wells (UIWs) are widespread throughout the state and occur in high concentration in several areas including areas in which ground water is highly sensitive to contamination. Class V wells release a wide variety of contaminants into or above aquifers supplying drinking water. The large number and diversity of Class V wells combined with lack of information regarding effects of these wells on ground water pose a significant potential threat to ground water. Indiana Class V wells are regulated by the USEPA. The USEPA has targeted some Class V wells which pose greater environmental risk and on April 5, 2000, more intensive regulations and enforcement for large capacity cesspools and motor vehicle waste disposal wells became effective.

Several cases of ground water contamination due to industrial facilities or their ancillary operations have been documented in Indiana. Although many contamination events occurred prior to the development of regulations for the storage and handling of industrial materials, ground water contamination still occurs as a result of either accidents or intentional dumping of waste. In May 1998, Indiana’s Secondary Containment of Aboveground Storage Tanks Containing Hazardous Materials Rule (327 IAC 2-10) was adopted. This rule requires that new facilities provide secondary containment unless there is less than 660 gallons at a facility that is not in an approved delineated wellhead protection area or less than 275 gallons at a facility that has been notified in writing by a water utility that it is in an approved delineated wellhead protection area. The secondary containment rule, along with outreach and education programs has alleviated a number of problems; however, these activities continue to be a potential source of contamination to ground water in Indiana.

The storage and extensive use of salt as a deicing agent during the winter months has an impact on ground water. Ground water contamination from road salt has been documented in Indiana. Efforts are being made by the Indiana Department of Transportation (INDOT) to build salt storage facilities in areas where ground water is not sensitive to contamination and to upgrade existing facilities to protect ground water. Currently all INDOT salt storage facilities are covered by domes or canopies and several new facilities were built to contain all surface runoff on-site to reduce ground water contamination. In addition, road salt usage and application rates have been significantly reduced from past years through computerized weather forecasting and roadway temperature sensors.

In 1999 and 2000, approximately 230 spills were reported on the average to IDEM per month. Ground water contamination as a result of spills can be avoided or minimized if spills are properly handled and cleaned up. Unreported spills may contribute to ground water contamination. Spill handling and clean up, when not properly executed, create a concern for ground water contamination. Indiana’s Spills; Reporting, Containment and Response Rule (327 IAC 2-6.1) ensures that spills are reported, properly handled and cleaned up.

Ground Water Protection Programs

Programs to monitor, evaluate, and protect ground water resources in Indiana occur at all levels of government. At the state level, several ground water protection programs and activities have been implemented or are in the process of being implemented. Table 26 lists the state's ground water protection programs and activities, developmental stage of the program or activity, and the agency or agencies responsible for the program's implementation and/or enforcement.

The Complaint Response program within the Ground Water Section at IDEM assists private well owners concerned with contamination of their drinking water from nearby sources and receives referrals from other IDEM program areas. Approximately 20% of complaints are followed up with residential well testing. For the time period extending from January 1, 1999 through December 31, 2000; approximately 500 telephone inquires and complaints concerning ground water contamination were received by the Complaint Response program. Eighty sites were field surveyed during this time period to evaluate the validity of well owners' concerns and to evaluate the potential for ground water contamination. Private well water sampling was conducted at 57 separate residential sites during this time period to investigate the potential for ground water contamination with 37 water samples indicating volatile organic compound (VOCS), synthetic organic compounds (SOCs), metals or nitrates. No well water sample results for any contaminant exceeded the Safe Drinking Water Act maximum contaminant level (MCL). Water samples from five wells indicated VOCs were detected at or below the method detection limits as was the case for 12 well samples in which SOCs were detected at or below the method detection limits. Metals were detected at nine wells with four samples greater than 50% of the MCL, but less than the MCL. Of the 57 sites sampled, a total of sixteen residences can be classified as having non-point source contamination detections while seventeen residences can be classified as having point source contamination detections.

In the event ground water contaminants were detected, the well owner was provided with information regarding public health concerns for the contaminants detected. If applicable, the home owner was also given information describing water treatment methods available on the open market. If point source contaminants are detected above the MCL, a referral is made to the appropriate regulatory authority for further action. Additionally, if the detected contaminant is a pesticide, then the case will follow the response to pesticides plan as identified in the State Management Plan for Pesticides in Ground Water (SMP). Ultimately, detections of pesticides or nutrients in ground water may lead to the implementation of best management practices (BMP's) at the affected location.

Table 26 Summary of State Ground Water Protection Programs (through 12/31/00)

PROGRAM OR ACTIVITY	STATUS	STATE AGENCY/ ORGANIZATION
Active SARA Title III Program	fully established	IDEM-OER
Ambient ground water monitoring program	fully established	OISC*, IDEM-OWQ
Aquifer sensitivity assessment	fully established	IDEM-OWQ, IDNR, IGS, OISC
Aquifer mapping/basin studies	under development	IDNR, IDEM-OWQ
Aquifer/ hydrogeologic setting characterization	fully established	IGS, IDEM-OWQ, IDNR
Bulk storage program for agricultural chemicals	fully established	OISC
Comprehensive data management system	pending	IDEM-OWQ
Complaint response program for private wells	fully established	IDEM-OWQ
Confined animal feeding program	fully established	IDEM-OWQ
EPA-endorsed Core Comprehensive State Ground Water Protection Program (CSGWPP)	under development	IDEM-OWQ, GWTF
Ground water discharge permits for constructed wetlands	under development	IDEM-OWQ
Ground water Best Management Practices	under development	OISC*, IDEM-OWQ
Ground water legislation	fully established	IDEM, IDNR, OISC, ISDH
Ground water classification	pending	IDEM-OWQ
Ground water quality standards	pending	IDEM-OWQ
Interagency coordination for ground water protection initiatives	pending	GWTF
Land application of domestic and industrial residuals	fully established	IDEM-OWQ
Nonpoint source controls	under development	IDEM-OWQ
Oil and Gas	fully established	IDNR
Pesticide State Management Plan	pending	OISC*, IDEM-OWQ
Pollution Prevention Program	fully established	IDEM-OPPTA
Reclamation	fully established	IDNR
Resource Conservation and Recovery Act (RCRA) Primacy	fully established	IDEM-OSHWM
Sensitivity assessment for drinking water/ wellhead protection	fully established	IGS, IDEM-OWQ
Spill Monitoring	fully established	IDEM-OWQ
State Superfund	fully established	IDEM-OSHWM/OER
State RCRA Program incorporating more stringent requirements than RCRA primacy	fully established	IDEM-OSHWM
State septic system regulations	fully established	ISDH
Underground storage tank installation requirements	fully established	IDEM-OER
Underground Storage Tank Remediation Fund	fully established	IDEM-OER
Underground Storage Tank Permit Program	fully established	IDEM-OER
Underground Injection Control Program	fully established for Class II wells	IDNR
Well abandonment regulations	fully established	IDNR
Wellhead Protection Program	fully established	IDEM-OWQ
Well installation regulations	fully established	IDNR

* indicates lead agency involved in enforcement or implementation

Acronyms Used:

GWTF Governor's Ground Water Task Force
IDEM Indiana Department of Environmental Management
IDNR Indiana Department of Natural Resources
IGS Indiana Geological Survey
ISDH Indiana State Department of Health
OER Office of Environmental Response (IDEM)
OISC Office of the Indiana State Chemist
OPPTA Office of Pollution Prevention and Technical Assistance (IDEM)
OSHWM Office of Solid and Hazardous Waste Management (IDEM)
OWQ Office of Water Quality (IDEM)

Definitions: "pending" is used to describe those programs that have a written, draft policy "under development" is used to describe those programs still in the planning stage

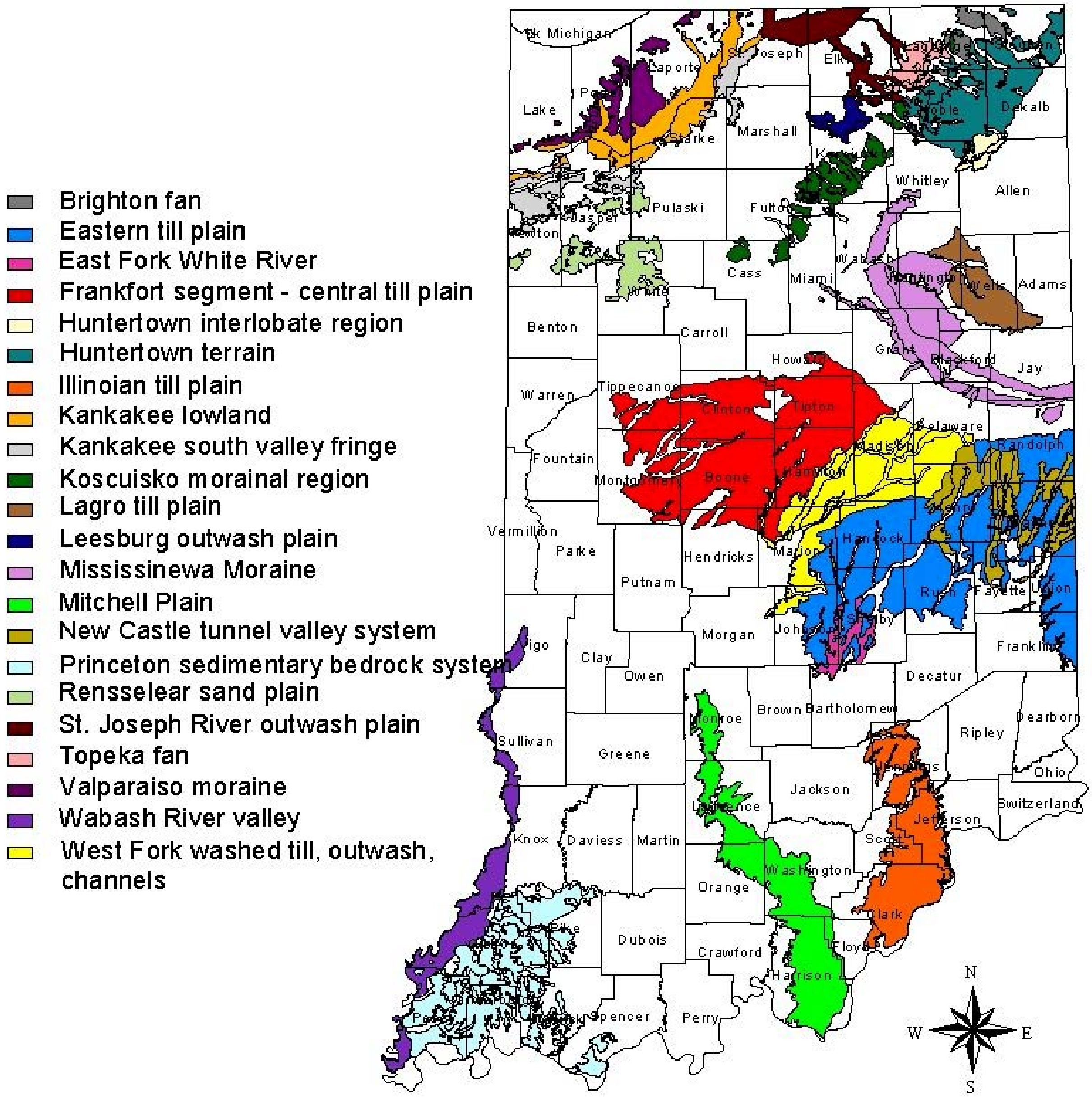
I n 1997, a pilot project was conducted for the ground water monitoring network component of the Pesticide State Management Plan. The monitoring network was established to provide a statistical evaluation of trends in pesticide occurrence and concentrations in major hydrogeologic settings of the state. Of the 230 hydrogeologic settings identified by the Indiana Geological Survey, approximately 60 were grouped into 22 "type" hydrogeologic settings that represent the state (Figure 9). For the pilot project, wells in two of the 22 "type" hydrogeologic settings were sampled for pesticides (SOCs), nitrates and metals along with general chemistry parameters. Quarterly sampling of the nearly 400 wells representing all 22 hydrogeologic settings was initiated in 1998 and wells sampled every 3-4 months for seven consecutive periods ending December 2000. Preliminary review indicates there are no clear or statistically significant detections of pesticides or VOC's in the wells sampled.

Indiana is currently developing Ground Water Quality Standards. Preliminarily adopted rule language provides protection to wells and allows for the classification of ground water into one of three classes: drinking water, naturally limited or impaired drinking water. Ground water is classified as drinking water class unless there is an approved verification that conditions exist making it impractical to use as drinking water. IDEM may classify ground water as "naturally limited" when ground water is shown to have a yield of less than 200 gallons per day or a total dissolved solids concentration of more than 10,000 ppm. Additionally, ground water that is in the crop root zone, in a coal mined area, or in an injection zone of a permitted Class I, II or III injection well or gas storage well may be considered naturally limited. IDEM may classify ground water with historic or other unaddressed contamination as "impaired" if mechanisms are in place to ensure no exposure to ground water that contains unsafe levels of contamination. Historic contamination is contamination that resulted from a facility, practice, or activity that was unregulated or under-regulated to protect ground water at the time the contaminant was released. To qualify for the impaired class the contaminants known to be in the ground water must be identified.

Indiana's Source Water Assessment Plan developed by Indiana stakeholders was approved by EPA in May 2000. IDEM contractors plan to identify the source water areas for each public water system, the watersheds and wellheads in Indiana that supply public drinking water. In the delineated source water areas, IDEM contractors will inventory the potential sources of contamination from regulated facilities and assess water system susceptibility to contamination. Approximately 4300 public water systems are scheduled to have source water assessments completed by May 2003.

In March 1997 the Indiana Wellhead Protection Rule (327 IAC 8-4.1) became effective, with EPA final approval of the Wellhead Protection Program in April of 1997. The Wellhead Protection Program is a proactive program that protects public water supplies from contamination. The Wellhead Protection Rule outlines the minimum requirements community public water supplies must meet to comply with the Wellhead Protection Program. At the end of 2000, 55 wellhead protection plans had been submitted to IDEM for review and 1 plan was approved for those communities which developed strategies to adequately protect their community water supplies from contamination.

Figure 8 Representative Hydrogeologic Setting Monitoring Networks



In addition to regulatory programs and other structured ground water protection activities listed in Table 26, there are several educational programs conducted in Indiana that place an emphasis on ground water protection. The Purdue University Extension program "Safe Water for the Future" is an umbrella for several programs that provide resources on drinking water protection for individuals and communities. The Farm*A*Syst and Home*A*Syst programs essentially are wellhead protection programs for rural and domestic private wells. A series of publications and brochures on wellhead protection are also available to assist communities working on wellhead protection. "Watershed Connections" brings together local contacts to produce a community-specific publication on water resources and their protection. Indiana Project WET (Water Education for Teachers) and Indiana's Water Riches are two general water education programs that provide information about ground water protection.

Several other coordinated education/information efforts conducted in Indiana address ground water protection. The statewide Clean Water Indiana education program focuses primarily on agriculture's contribution to water quality contamination from soil and water related resources. Aspects of this program that deal with ground water protection include nutrient and pest management, plugging abandoned water wells, and land use. The Water Quality (WQ) series of over 30 Purdue Extension publications addresses specific topics for the general public. Purdue Pesticide Programs publication "Pesticides and Water Quality" (PPP-35) describes the protection measures taken by manufacturers, handlers, and end users of pesticides to protect water quality and discusses the end "fate" of applied pesticides in the environment. "Your Link to Water Quality" is a brochure that provides resources available through Purdue Extension to address water quality concerns related to agriculture, homeowners, and communities.

Nitrate Sampling in 22 Representative Hydrogeologic Settings

Ground water monitoring for nitrate was done in 22 monitoring well networks which were selected as representative of Indiana's hydrogeology (see Figure 9). Of the 22 hydrogeologic settings sampled, five of the 22 areas sampled indicated levels of nitrates greater than two parts per million (ppm). Monitoring well networks 1, 3, 16, 18, and 21 indicate elevated nitrate levels and are included in Table 27 with nitrate sampling results for the 22 well networks sampled.

Table 27 summarizes the nitrate results for the ground water monitoring network. Nitrate detections were grouped for the following levels: less than 2 ppm (several studies state that levels up to 2 and 3 ppm can be from naturally occurring sources), 2 - 4.9 ppm , 5- 9.9 (5 being half the MCL), and NO3 =/> 10 ppm (10 being the MCL). Nitrate results are from the summer of 1998 with the exception of less than 10% of results coming from another sampling period (in cases where the site was not yet in the monitoring network or results were missing). Other sampling periods in which nitrates were taken had an insufficent number of wells sampled. Overall, sites with detections did consistently have detections from sampling period to sampling period with little variation in nitrate level.

The networks shaded (1 ,3, 16, 18 and 21) are those that have the highest percentage of nitrate detections of 5.0 and greater. Several of these networks had a limited number of sampling sites and insufficient data exists to draw conclusions. Networks with an adequate number of sample sites and no nitrate problems are easily identifiable: 7, 8, 9, 13, 14, 15, and 20. Networks 6 and 10 also seem to have no nitrate problems, but have less than 20 sampling sites per network.

Table 27 Summary of Nitrate Sample Results

NETWORK	COUNTIES INCLUDED	Tt # WELLS	N03 < 2.0	NO3 2.0 – 4.9	N03 5.0 – 9.9	N03 =/> 10
1=TOPEKA FAN	Lagrange, Noble	18	13	0	4	1
2=LEESBURG OUTWASH PLAIN	Kosciusko	12	10	0	0	2
3=BRIGHTON FAN	LaGrange, Steuben	15	9	0	2	4
4=VALPARAISO MORAINE	Porter, LaPorte, Lake	10	0	2	0	0
5=KANKAKEE LOWLAND	Lake, Porter, LaPorte, St. Joseph, Starke, Jasper, Newton	8	7	0	0	1
6=MISSISSINEWA MORAINE	Whitley, Wabash, Huntington, Grant, Blackford, Jay, Delaware, Randolph	12	12	0	0	0
7=HUNTERTOWN INTERLOBATE REGION	Allen	20	20	0	0	0
8=KOSCIUSCO MORAINAL REGION	Cass, Miami, Fulton, Kosciusko, Noble, Lagrange	25	25	0	0	0
9=NATURAL LAKES AND MORAINES	Lagrange, Steuben, Noble, DeKalb, Fulton, Whitley, Marshall	28	27	0	1	0
10=LAGRO TILL PLAIN/ SHALLOW BEDROCK	Huntington, Wells, Adam	13	13	0	0	0
11=ILLINOIAN TILL PLAIN	Jennings, Jefferson, Scott, Clark, Floyd	12	9	2	1	0
12=RENSSELAER SAND PLAIN	Newton, Jasper, White, Pulaski	12	10	1	1	0
13=EFWW SEGMENT EASTERN TILL PLAIN	Randolph, Wayne, Union, Franklin, Fayette, Henry, Rush, Hancock, Shelby, Marion,	29	28	0	0	1
14=WF SEGMENT FRINGING WASHED TILL PLAIN	Delaware, Henry, Madison, Hamilton, Marion, Johnson	21	21	0	0	0
15=FRANKFORT SEGMENT CENTRAL TILL PLAIN	Madison, Howard, Tipton, Hamilton, Clinton, Tippecanoe, Boone, Montgomery, Hendricks, Marion	46	46	0	0	0
16=E FORK WHITE RIVER	Shelby, Johnson, Bartholomew	7	4	0	1	2
17=ST JOSEPH/ ELKHART RIVER OUTWASH PLAIN	St. Joseph, Elkhart, Lagrange, Noble, Kosciusko	13	10	1	1	1
18=WABASH RIVER VALLEY	Vigo, Sullivan, Knox, Gibson, Posey	10	3	1	5	1
19=NEW CASTLE TUNNEL VALLEY SYSTEM	Delaware, Randolph, Henry, Wayne, Fayette, Union, Rush	10	8	1	1	0
20=KANKAKEE-SOUTHERN VALLEY FRINGE	Newton, Jasper, Starke, Marshall, St. Joseph, Pulaski	30	28	2	0	0
21=MITCHELL PLAIN KARST	Monroe, Lawrence, Orange, Washington, Harrison, Floyd	16	11	2	2	1
22=INTERBEDDED	Pike, Gibson, Posey,	5	5	0	0	0

NETWORK	COUNTIES INCLUDED	Tt # WELLS	N03 < 2.0	NO3 2.0 – 4.9	N03 5.0 – 9.9	N03 =/> 10
SEDIMENTARY ROCKS	Vanderburg, Warrick, Spencer					

Additional factors such as depth of wells, well construction, and land use may have contributed to the results associated with wells in the networks of potential concern.

Ground Water for Drinking Water Monitoring Data

Ground water quality data for public water supplies in the five hydrogeologic settings with elevated nitrate (networks 1, 3, 16, 18 and 21) is summarized in Tables 28, 29, 30, 31, and 32. The public water supply data is a summary of systems having mailing addresses containing cities that were in the counties included in these hydrogeologic settings.

Data obtained from Community and Noncommunity Public Water Supply (PWS) ground water systems was collected from the IDEM Drinking Water Branch PWS Compliance Section. Results are reported for volatile organic compounds (VOCs), synthetic organic compounds (SOCs), inorganic compounds (IOCs), nitrates (NO_3), and radionuclides. Community and Noncommunity nontransient systems are required to test for 30 regulated SOCs, and 21 VOCs. Community systems monitor for 12 regulated IOCs and sodium (a special monitoring requirement). Nontransient noncommunity systems monitor for 11 regulated IOCs (excluding sodium and fluoride). All public water supply systems including transient noncommunity are required to test for nitrates. Only community systems are required to monitor for radionuclides. Radionuclide monitoring consists of analysis for gross alpha particle activity. Samples collected by PWS are from entry points, which occur after treatment and before the distribution system. Entry point data can be from a single well or blended from two or more wells. For PWS data, the reporting period was dependent on sampling frequency requirements for the parameter group. For VOC, SOC, and IOC data, community and nontransient noncommunity systems are required to sample a minimum of once every three years (more frequently if certain levels of contaminants are detected); therefore, data for these parameters is summarized for the sampling period, 1999-2000. Nitrates are an annual sampling requirement for all PWS systems; therefore, nitrate data is summarized for 2000. Only community systems are required to test for radionuclides and radionuclide data are summarized for 2000. Public water supply system data indicates that ground water quality is generally good. Nitrates were the most common contaminant detected in both hydrogeologic settings; however, most detected concentrations were at low levels. Nitrate concentrations of 2 ppm or less are considered to be naturally occurring in ground water.

Table 28 Summary of Ground Water for Drinking Water Monitoring Data.

Hydrogeologic Setting: Topeka fan

Network: 1

Counties included: LaGrange, Noble

Monitoring Data Type	Total No. of Entry Points[1] or Wells in Assess-ment	Parameter Groups	Number of Entry Points[1] or Wells					
			No detections above MDL; NO_3 < 1 ppm	Detection > MDL and < 50% of MCL; NO_3 >/= 1 and < 50% MCL	Detection = or > 50% of MCL and < MCL	Detection = or > MCL	Removed from service[3]	Special Treatment[3]
Entry point Ground Water Quality Data from Community PWS	0	VOC	0	0	0	0	0	0
	0	SOC	0	0	0	0	0	0
	0	IOC	168	53	4	4	0	0
	26	NO_3	24	1	0	0	0	0
	0	Radionuclides	0	0	0	0	0	0
Entry point Ground Water Quality Data from Non-community transient[4] and non-transient PWS	0	VOC	0	0	0	0	0	0
	0	SOC	0	0	0	0	0	0
	0	IOC	156	33	0	0	0	0
	229	NO_3	166	29	8	6	0	0
		Radionuclides[5]						

1 PWS system data collected per entry point (narrative)
2 Data collected from private wells in IDEM complaint response program
3 Action due to contaminated ground water (source water)
4 Transient communities only required to monitor for NO_3
5 Radionuclides not required for noncommunity systems

Table 29 Summary of Ground Water for Drinking Water Monitoring Data.

Hydrogeologic Setting: Brighton Fan

Network: 3

Counties included: LaGrange, Steuben

Monitoring Data Type	Total No. of Entry Points[1] or Wells in Assessment	Parameter Groups	Number of Entry Points[1] or Wells					
			No detections above MDL; NO_3 < 1 ppm	Detection > MDL and < 50% of MCL; NO_3 >/= 1 and < 50% MCL	Detection = or > 50% of MCL and < MCL	Detection = or > MCL	Removed from service[3]	Special Treatment[3]
Entry point Ground Water Quality Data from Community PWS	0	VOC	0	0	0	0	0	0
	0	SOC	0	0	0	0	0	0
	0	IOC	0	0	0	0	0	0
	29	NO_3	24	4	0	0	0	0
	0	Radionuclides	0	0	0	0	0	0
Entry point Ground Water Quality Data from Non-community transient[4] and non-transient PWS	0	VOC	0	0	0	0	0	0
	0	SOC	0	0	0	0	0	0
	0	IOC	0	(0)	0	0	0	0
	288	NO_3	210	30	3	5	0	0
		Radionuclides[5]						

1 PWS system data collected per entry point (narrative)
2 Data collected from private wells in IDEM complaint response program
3 Action due to contaminated ground water (source water)
4 Transient communities only required to monitor for NO_3
5 Radionuclides not required for noncommunity systems

Table 30 Summary of Ground Water for Drinking Water Monitoring Data.

Hydrogeologic Setting: Central East Fork White river

Network: 16

Counties included: Shelby, Johnson, Bartholomew

Monitoring Data Type	Total No. of Entry Points[1] or Wells in Assess-ment	Parameter Groups	Number of Entry Points[1] or Wells					
			No detections above MDL; NO_3 < 1 ppm	Detection > MDL and < 50% of MCL; NO_3 >/= 1 and < 50% MCL	Detection = or > 50% of MCL and < MCL	Detection = or > MCL	Removed from service[3]	Special Treatment[3]
Entry point Ground Water Quality Data from Community PWS	0	VOC	0	0	0	0	0	0
	0	SOC	0	0	0	0	0	0
	0	IOC	0	0	0	0	0	0
	24	NO_3	10	11	3	0	0	0
	0	Radionuclides	0	0	0	0	0	0
Entry point Ground Water Quality Data from Non-community transient[4] and non-transient PWS	0	VOC	0	0	0	0	0	0
	0	SOC	0	0	0	0	0	0
	0	IOC	0	(0)	0	0	0	0
	94	NO_3	58	13	5	3	0	0
		Radionuclides[5]						

1 PWS system data collected per entry point (narrative)
2 Data collected from private wells in IDEM complaint response program
3 Action due to contaminated ground water (source water)
4 Transient communities only required to monitor for NO_3
5 Radionuclides not required for noncommunity systems

Table 31 Summary of Ground Water for Drinking Water Monitoring Data.

Hydrogeologic Setting: Wabash River valley

Network: 18

Counties included: Vigo, Sullivan, Knox, Gibson, Posey

Monitoring Data Type	Total No. of Entry Points[1] or Wells in Assessment	Parameter Groups	Number of Entry Points[1] or Wells					
			No detections above MDL; NO_3 < 1 ppm	Detection > MDL and < 50% of MCL; NO_3 >/= 1 and < 50% MCL	Detection = or > 50% of MCL and < MCL	Detection = or > MCL	Removed from service[3]	Special Treatment[3]
Entry point Ground Water Quality Data from Community PWS	0	VOC	0	0	0	0	0	0
	0	SOC	0	0	0	0	0	0
	0	IOC	0	0	0	0	0	0
	43	NO_3	14	15	10	4	0	0
	0	Radionuclides	0	0	0	0	0	0
Entry point Ground Water Quality Data from Non-community transient[4] and non-transient PWS	0	VOC	0	0	0	0	0	0
	0	SOC	0	0	0	0	0	0
	0	IOC	0	(0)	0	0	0	0
	54	NO_3	25	14	7	1	0	0
		Radionuclides[5]						

1 PWS system data collected per entry point (narrative)
2 Data collected from private wells in IDEM complaint response program
3 Action due to contaminated ground water (source water)
4 Transient communities only required to monitor for NO_3
5 Radionuclides not required for noncommunity systems

Table 32 Summary of Ground Water for Drinking Water Monitoring Data.

Hydrogeologic Setting: Mitchell Plain Karst

Network: 21

Counties included: Monroe, Lawrence, Orange, Washington, Harrison, Floyd

Monitoring Data Type	Total No. of Entry Points[1] or Wells in Assessment	Parameter Groups	Number of Entry Points[1] or Wells					
			No detections above MDL; NO_3 < 1 ppm	Detection > MDL and < 50% of MCL; NO_3 >/= 1 and < 50% MCL	Detection = or > 50% of MCL and < MCL	Detection = or > MCL	Removed from service[3]	Special Treatment[3]
Entry point Ground Water Quality Data from Community PWS	0	VOC	0	0	0	0	0	0
	0	SOC	0	0	0	0	0	0
	0	IOC	0	0	0	0	0	0
	10	NO_3	1	8	1	0	0	0
	0	Radionuclides	0	0	0	0	0	0
Entry point Ground Water Quality Data from Non-community transient[4] and non-transient PWS	0	VOC	0	0	0	0	0	0
	0	SOC	0	0	0	0	0	0
	0	IOC	0	(0)	0	0	0	0
	8	NO_3	3	2	1	0	0	0
		Radionuclides[5]						

[1] PWS system data collected per entry point (narrative)
[2] Data collected from private wells in IDEM complaint response program
[3] Action due to contaminated ground water (source water)
[4] Transient communities only required to monitor for NO_3
[5] Radionuclides not required for noncommunity systems